

Tissue Engineering and Disease Modeling

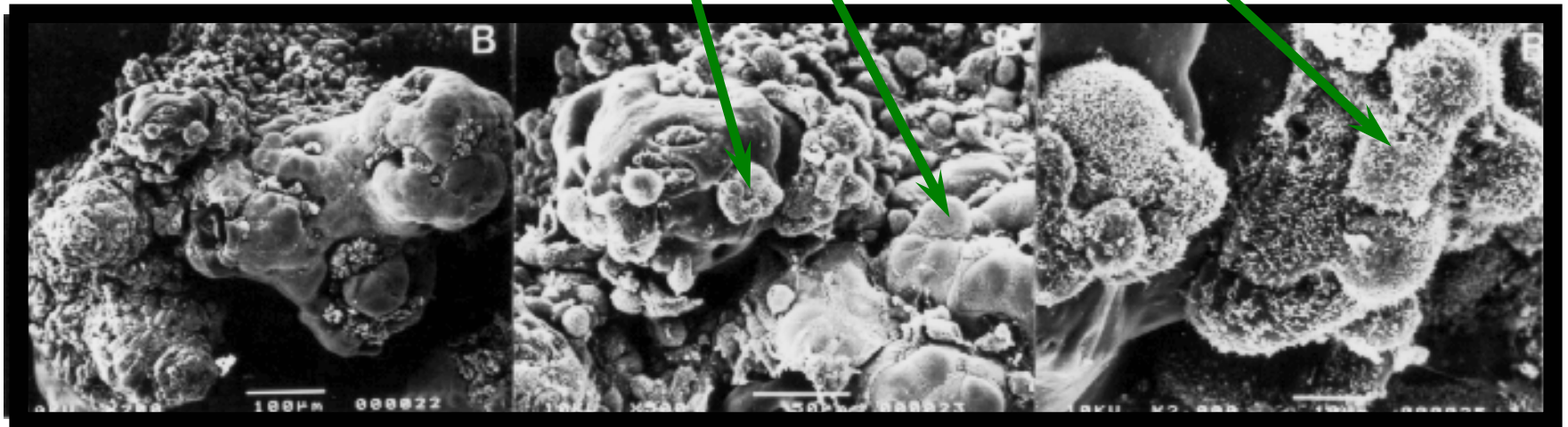
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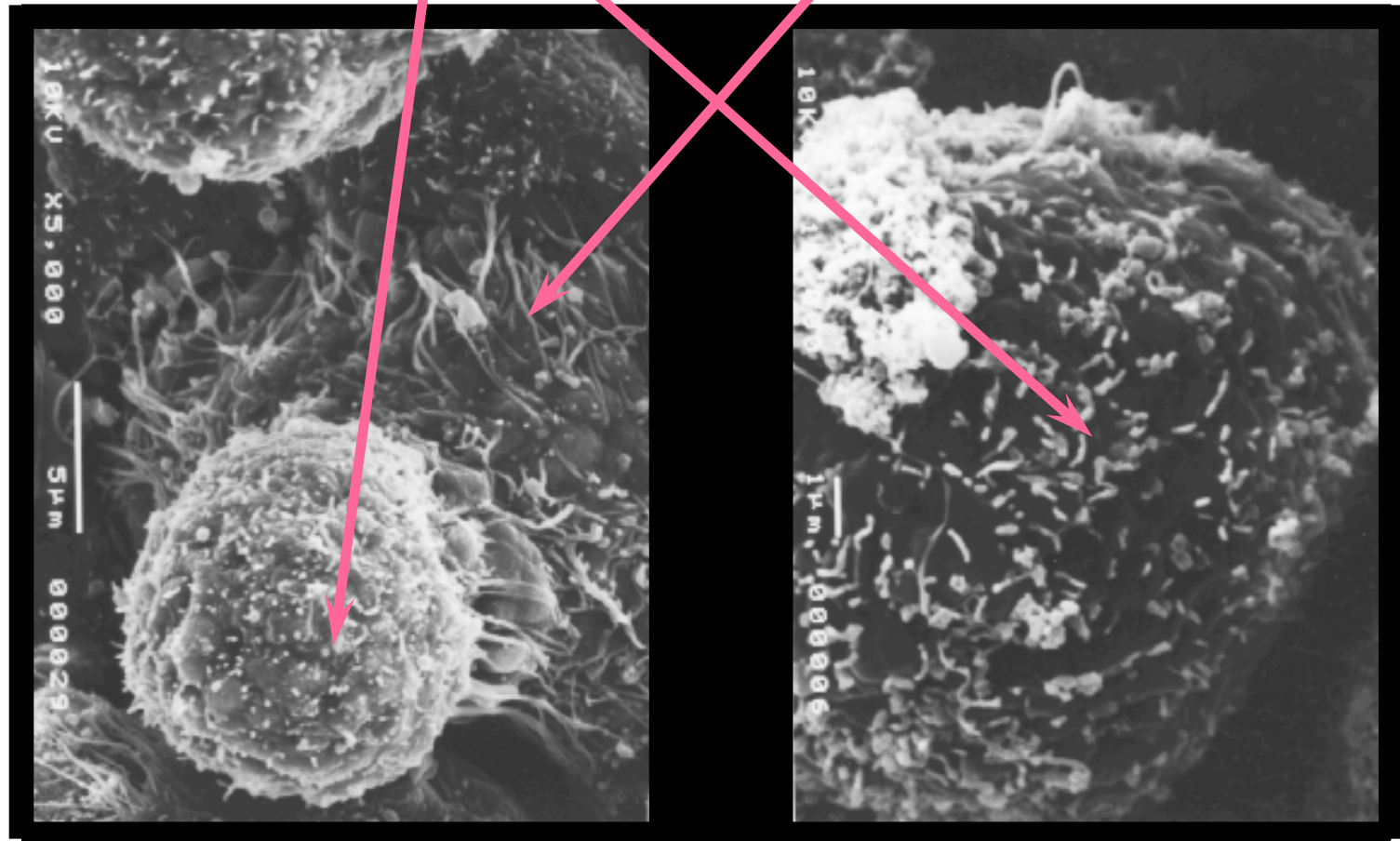
Dynamic Models in Cancer Research

Human Immune Cells
Invading Three Dimensional
Breast Cancer from the Bioreactor



Production of Liver Tissue

Cellular shape () and arrangement () enabling investigation of infection in a more native tissue model

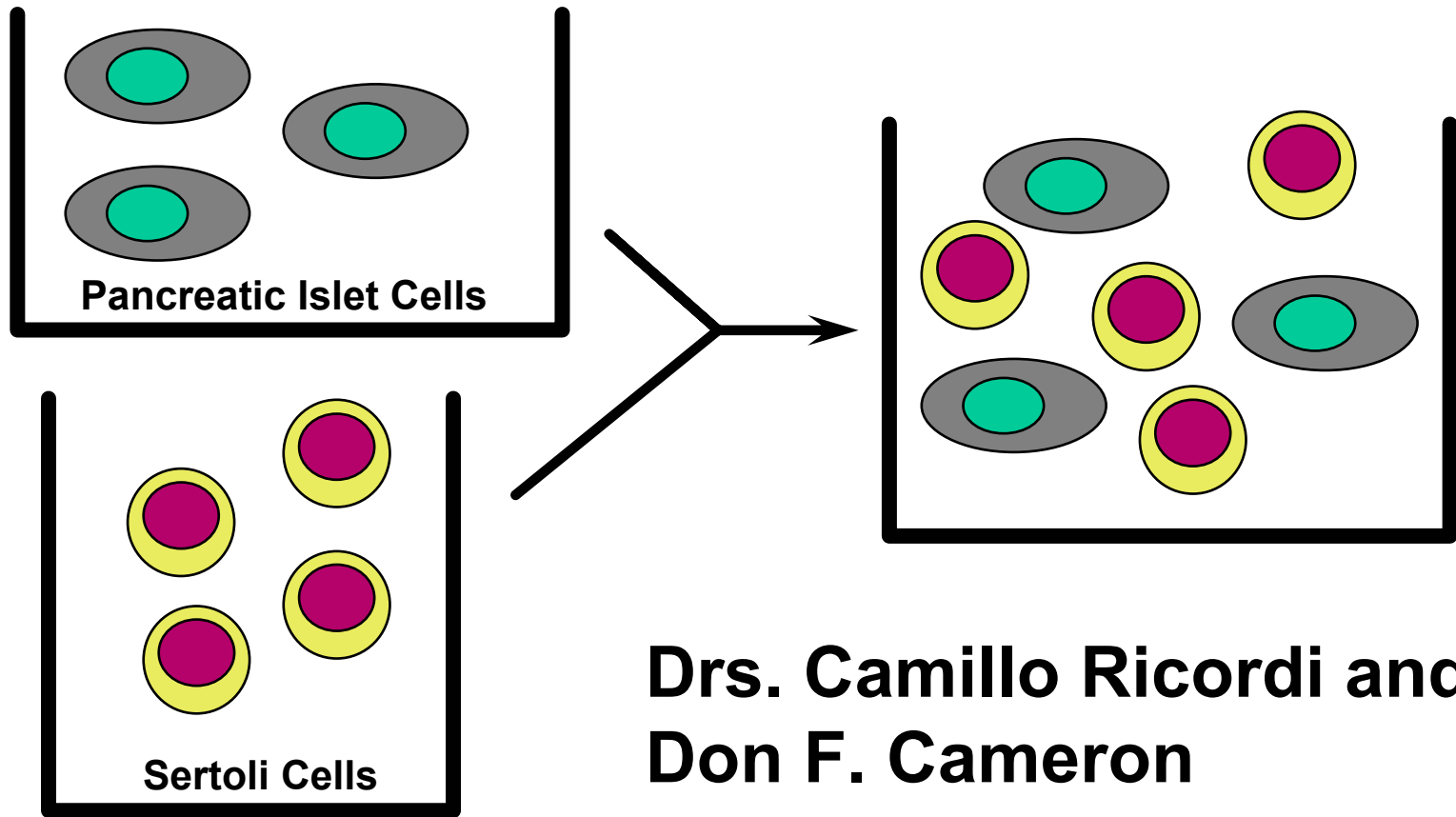


Liver Tissue Morphogenesis

- Hepatitis virus pathogenesis model (BCM)
- Drug metabolism (StelSys, Inc.)
- Toxicology testing
- Extracorporeal liver support technology (StelSys, Inc.)

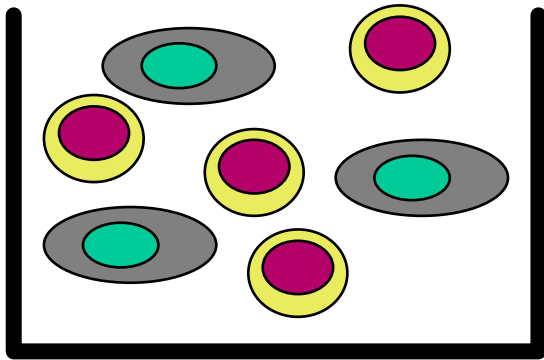
Diabetes Treatment Models

Co-transplantation

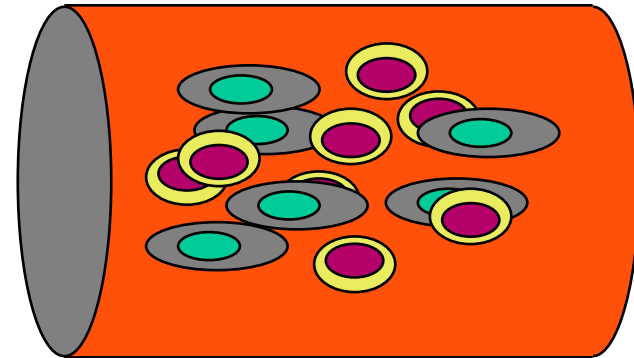


**Drs. Camillo Ricordi and
Don F. Cameron**

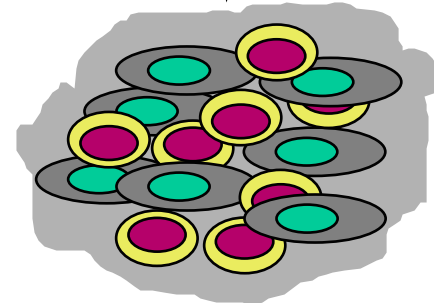
Diabetes Treatment Model



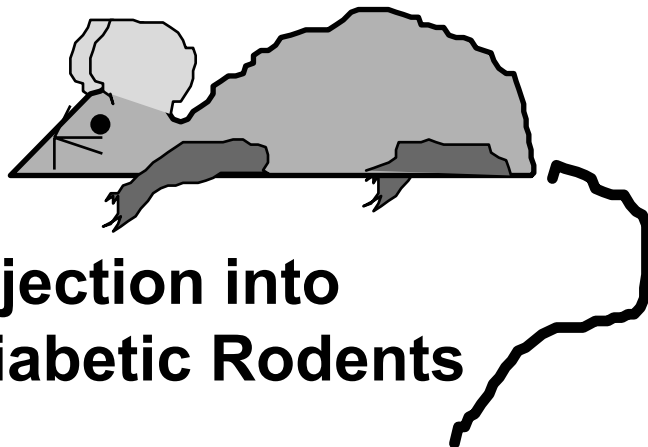
Mixed Culture



NASA Bioreactor



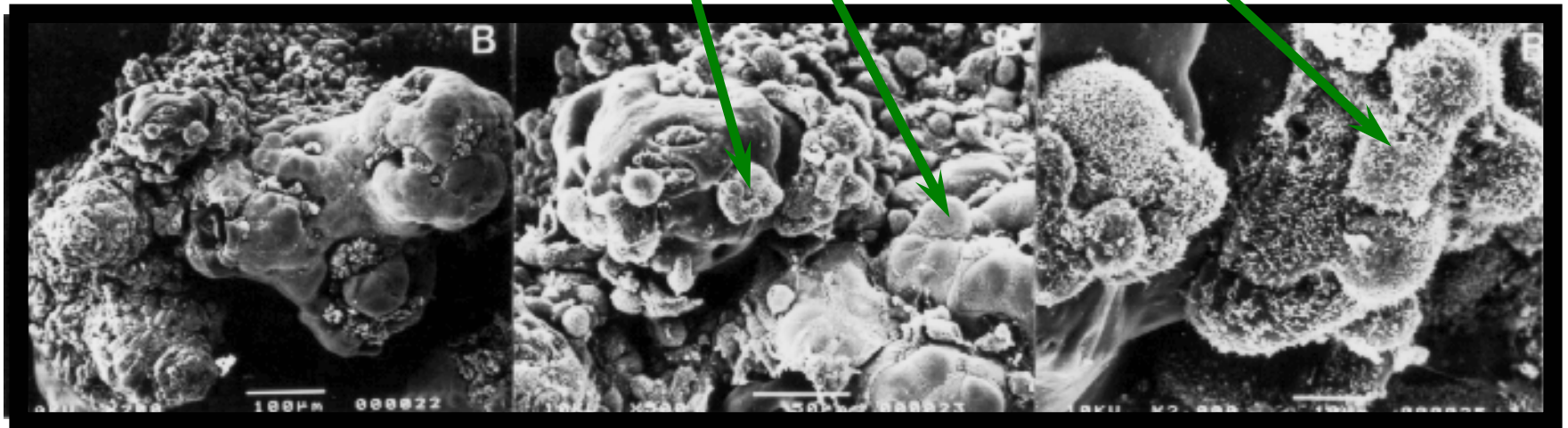
Immuno-resistant Assembly



**Injection into
Diabetic Rodents**

Dynamic Models in Cancer Research

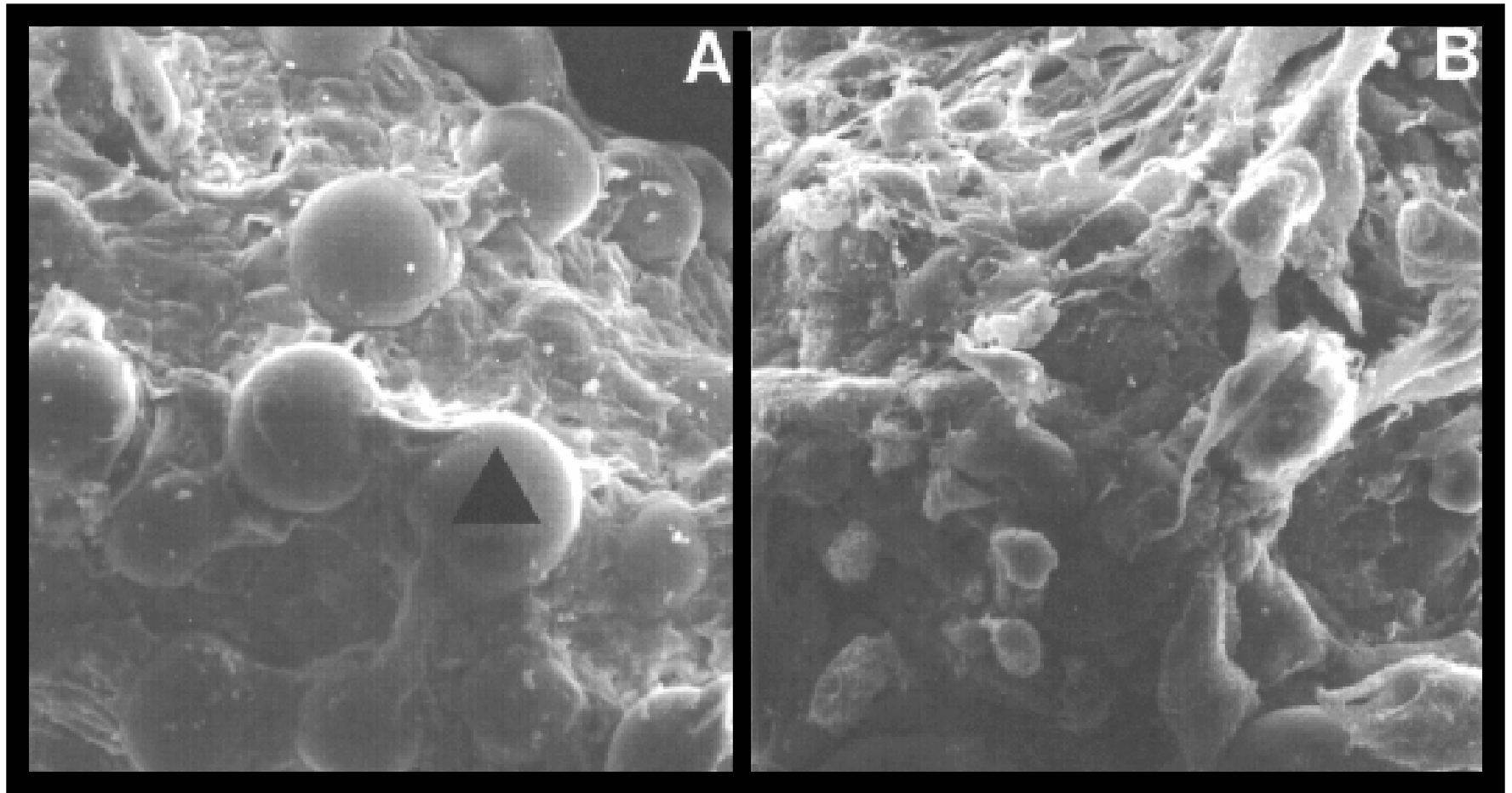
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Human Breast Cancer

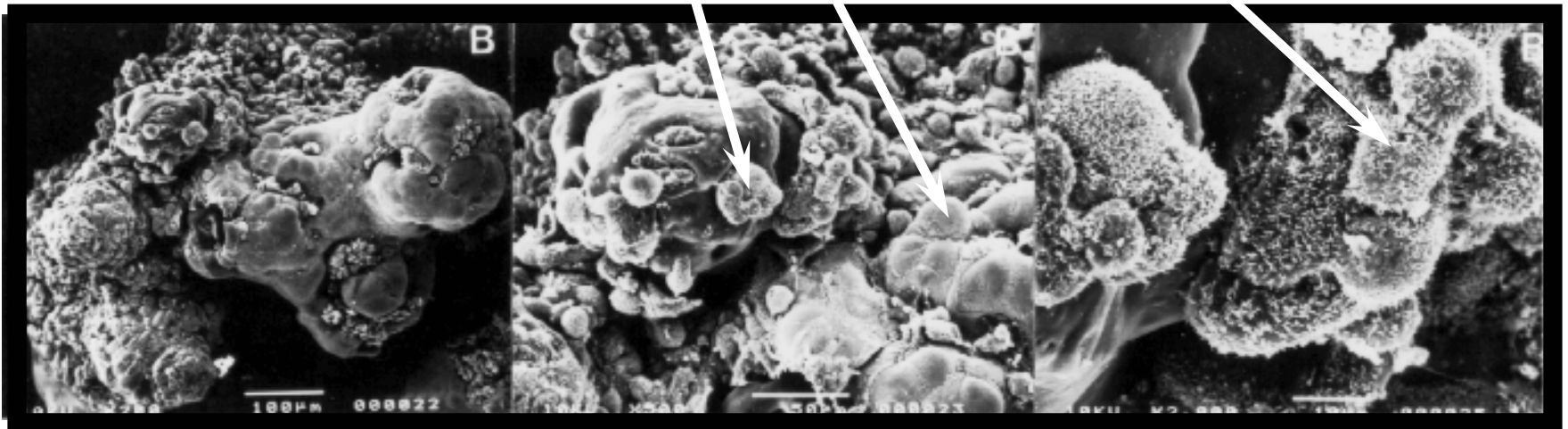
- Investigator- Dr. Jeanne Becker,
University of South Florida
- Aneuploid
- Large mitotic fraction
- Six out of seven specimens propagated

Primary Breast Carcinoma



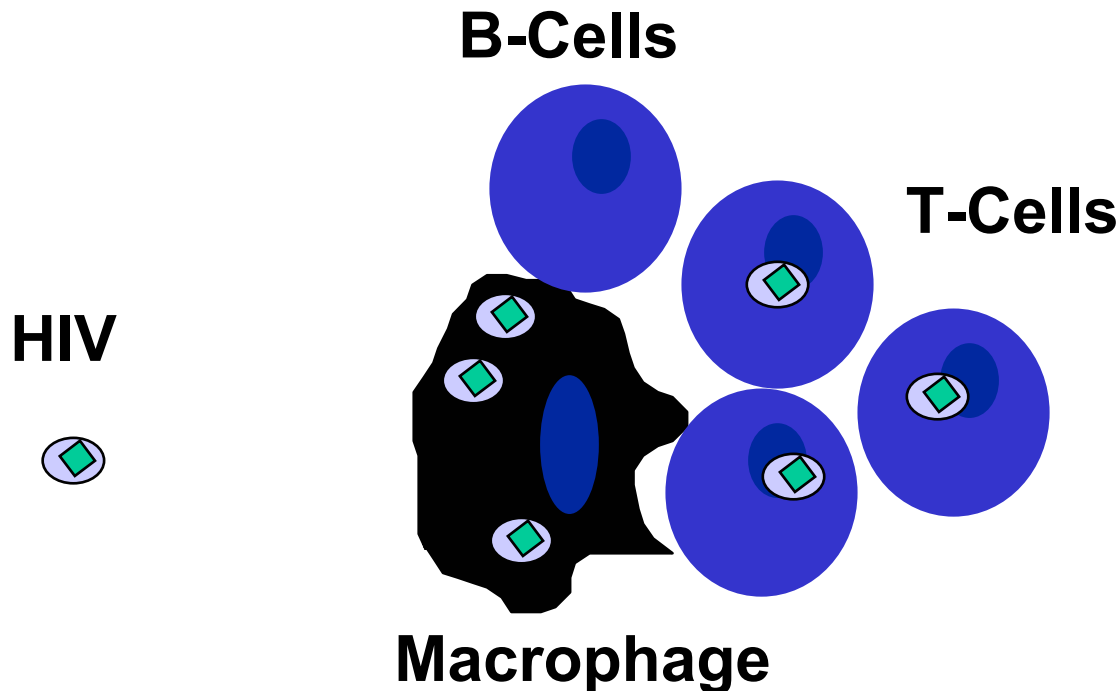
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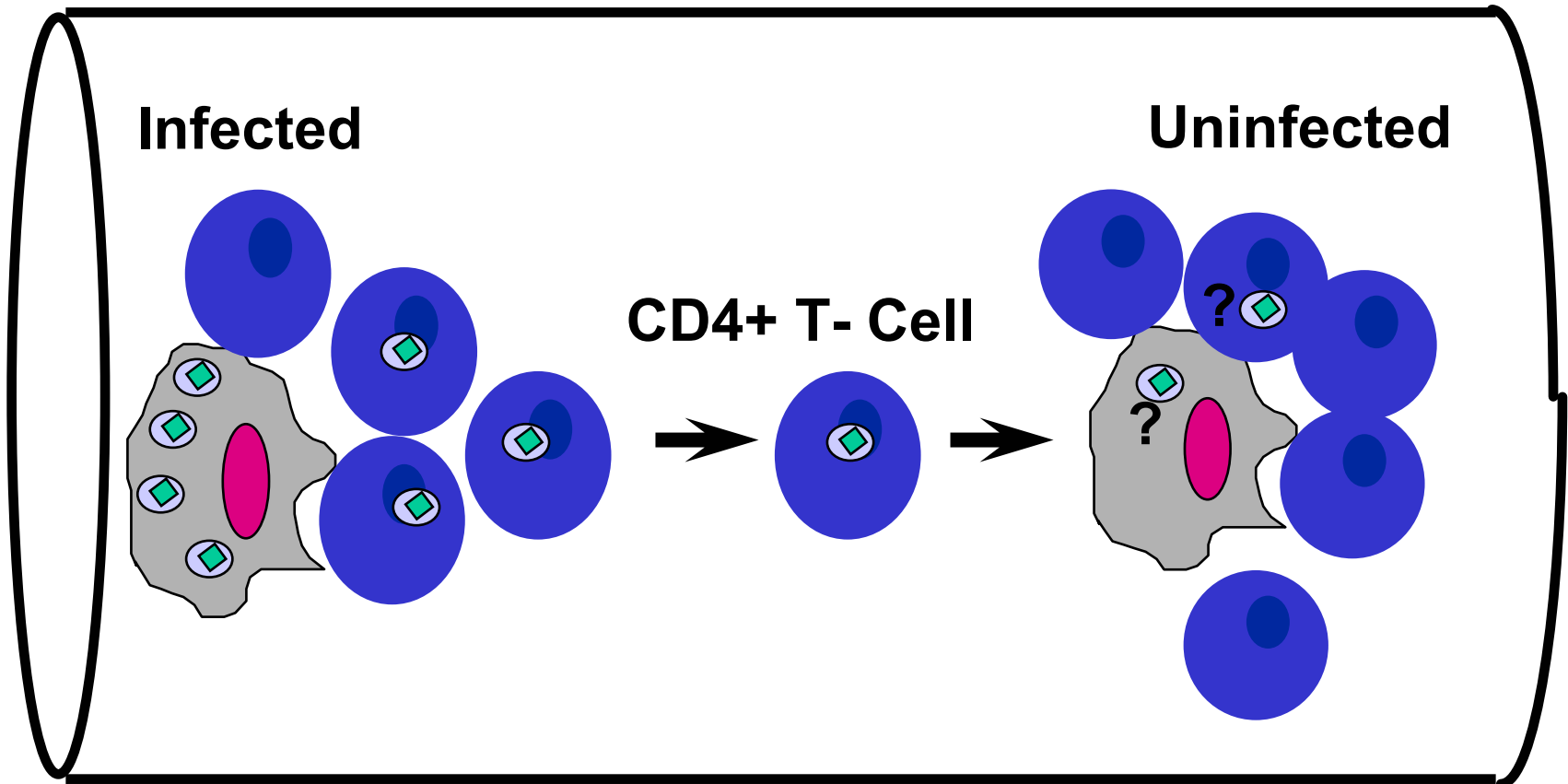
Recent Investigations

- NIH-- Zimmerberg and Margolis (NICHHD)---- *HIV Pathogenesis*



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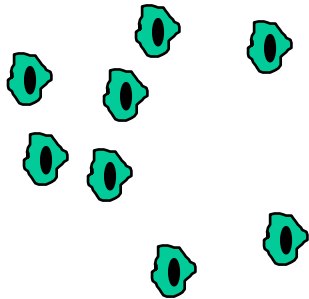
Prospects

- Advanced understanding of HIV pathogenesis
- Revised strategy for chemotherapy
- Revised strategy for vaccine development

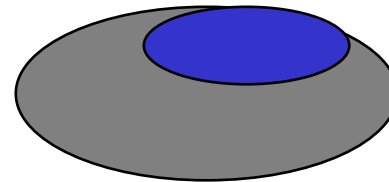
Recent Investigations

- FDA /NIH/NASA-- Cyclospora

Cyclospora

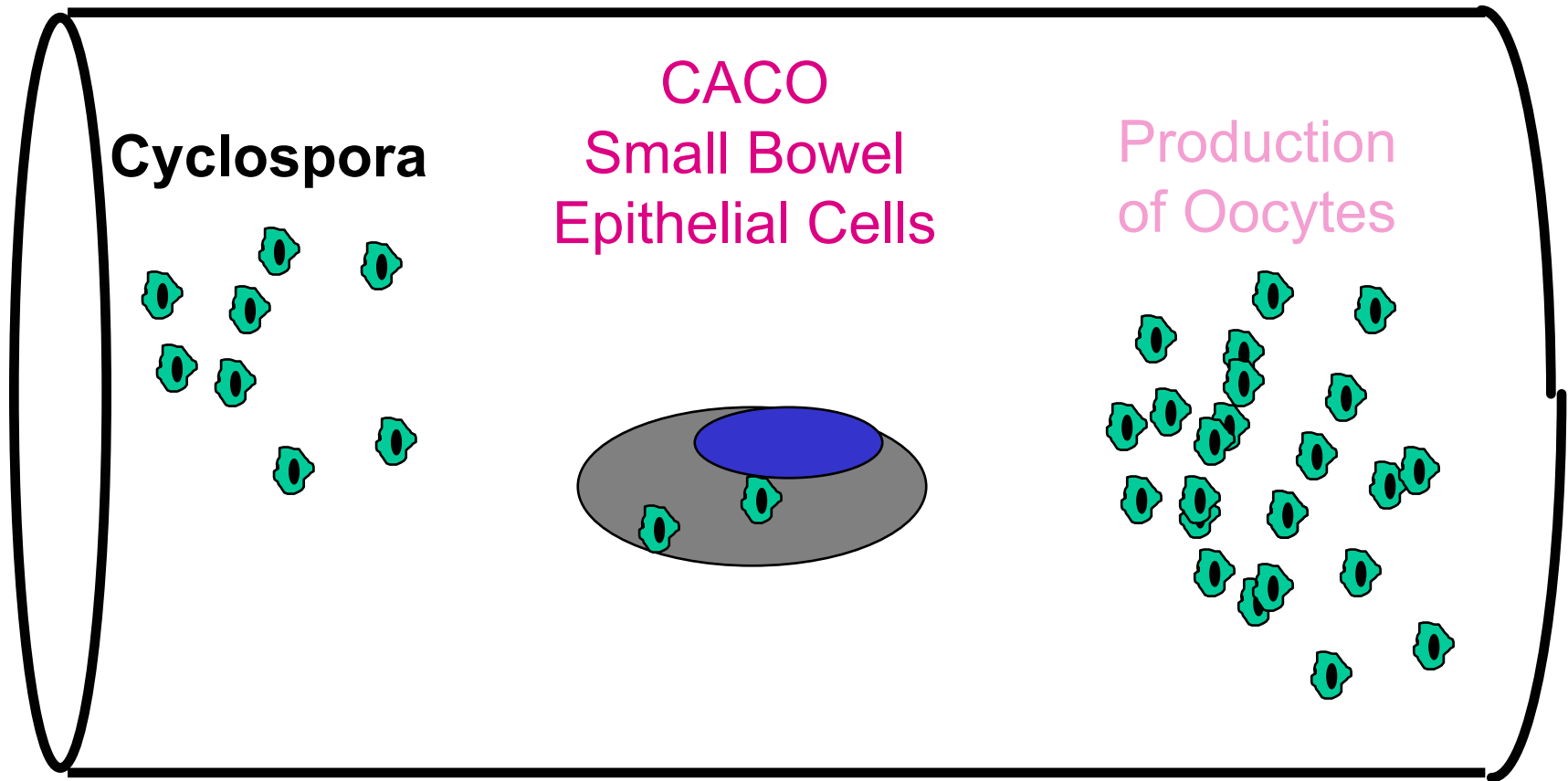


CACO
Small Bowel
Epithelial Cells



Recent Investigations

FDA /NIH/NASA-- Cyclospora



Prospects

- Identification of the small bowel as the target tissue in Cyclospora induced illness
- Propagation of the causative agent is the critical step in the development of vaccines for prevention and drugs for treatment

STS-89 Mir Increment 7

Experiment:

Co-Cult is the simultaneous culturing of two different kinds of cells with the intent of producing a functional unit of tissue.

In this instance human breast cancer is used as a tissue model to develop the growth of blood vessels that can supply nutrients to cells deep in the tissue

STS-89 Mir Increment 7

Experiment Protocol:

The cells that form blood vessels are called endothelial cells. Human blood vessel endothelial cells (HIVE-86) are placed in the NASA bioreactor 10 days before launch to Mir.

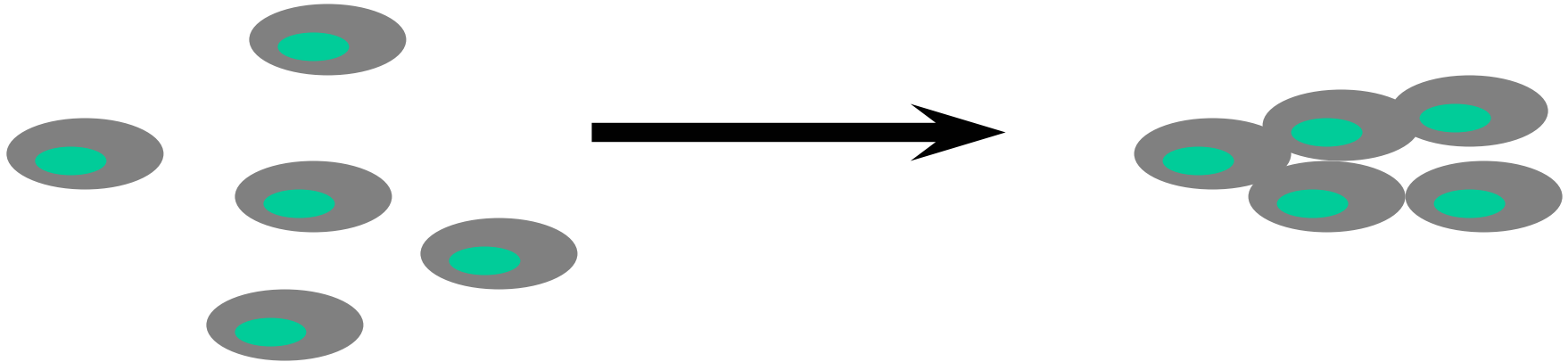
Seven days later human breast cancer cells (MCF-7) are added to the culture.

Three days later the Bioreactor and contents are launched to Mir.

On Mir the culture is continued for >100 days during which specimens are taken and analyzed on site or archived for post-flight analysis.

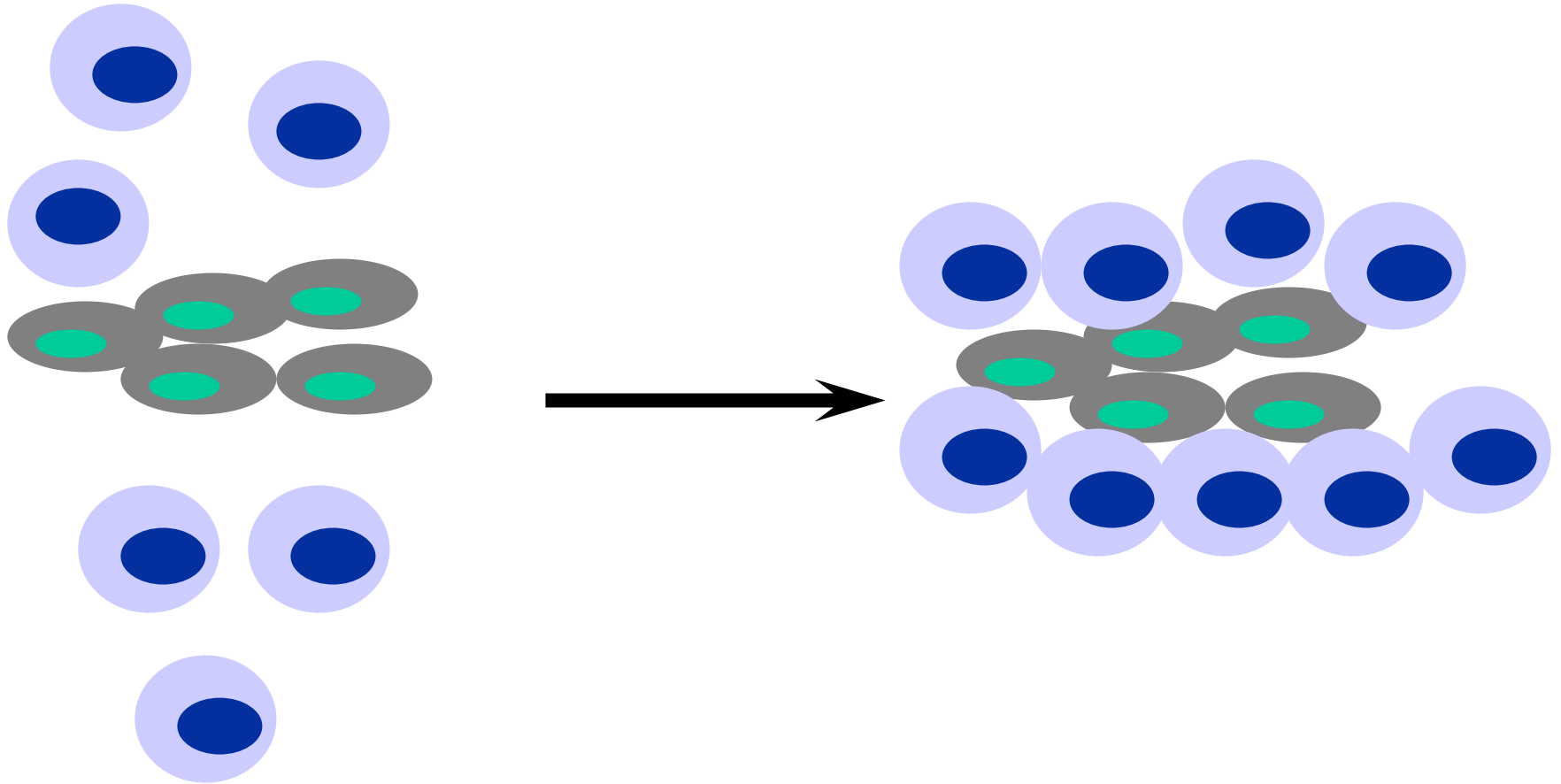
STS-89 Mir Increment 7

Anticipated Results:



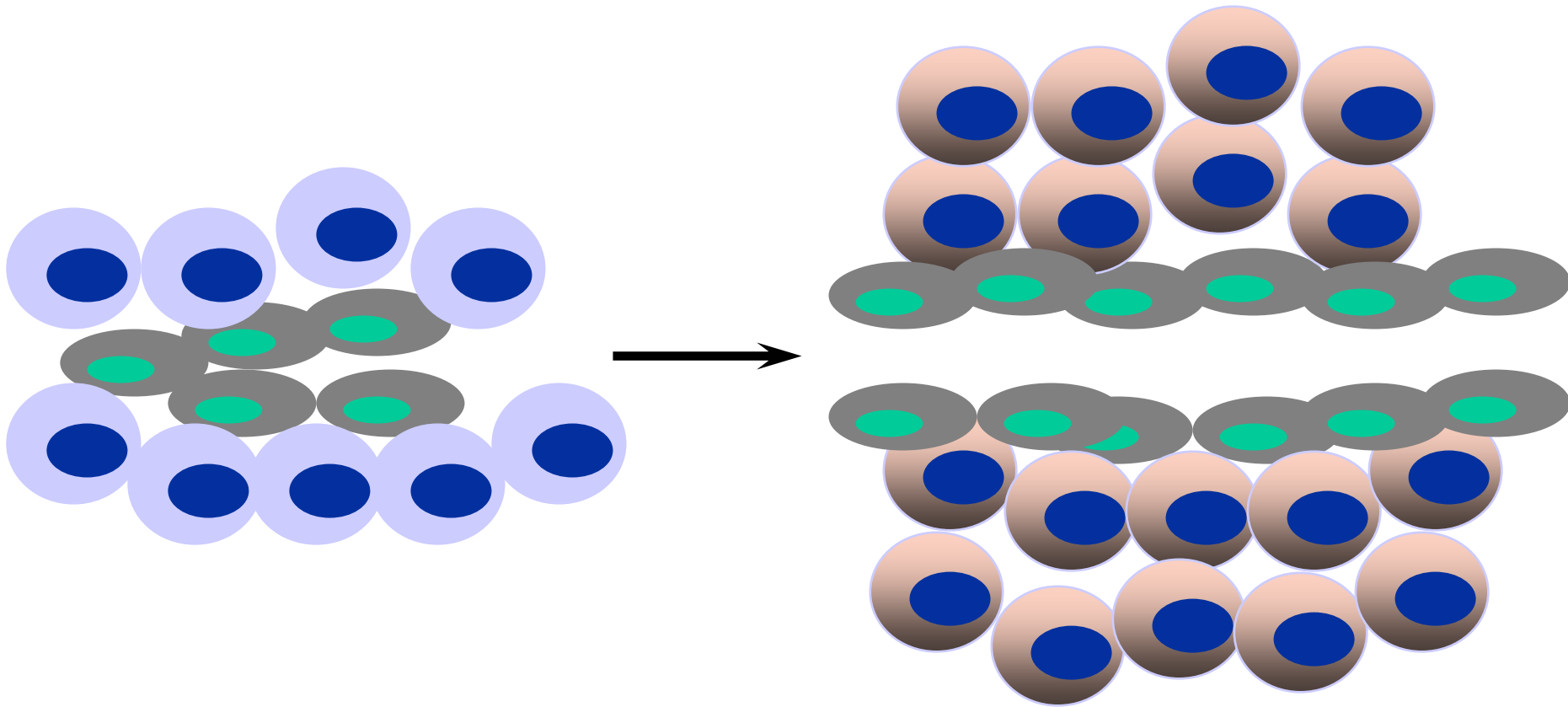
Endothelial Cell Assembly and 3-D Growth

STS-89 Mir Increment 7



**Assembly and Propagation of Breast Cancer Cells
in Space**

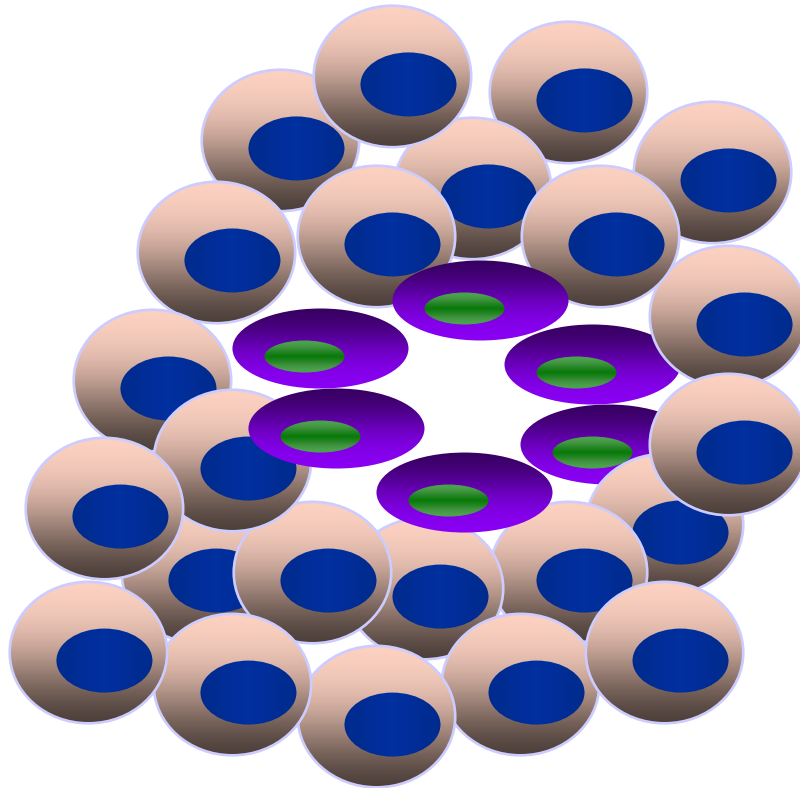
STS-89 Mir Increment 7



Growth of the tissue and formation of the tubules that resemble capillaries or blood vessels

STS-89 Mir Increment 7

Goal of the experiment:



Cross sectional view of the breast cancer tissue with a primitive capillary inside

Summary

- Microgravity offers a unique environment that re-orders the forces exerted on cells
- The response of cells to the re-ordering provides novel insights into cellular mechanisms
- Cells unloaded from gravity may perform to our advantage in tissue morphogenesis
- The response of cells to microgravity provides the doorway 1) to understanding the the human experience in space, 2) to transitioning terrestrial life to low gravity environments, and 3) to which characteristics favor thriving in microgravity and may be already expressed in exbiologic life